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Mission Need Statement for the OU 7-13/14 ISG Project

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Mission Need Statement for the OU 7-13/14 ISG Project

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Revision 0

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ABSTRACT

This mission need statement justifies using in situ grouting as an early action (i.e., action that can be initiated before the record of decision for Operable Unit 7-13/14) and for continuing remedial action to stabilize fission and activation product contaminants of concern disposed of in the Subsurface Disposal Area, a radioactive landfill at the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory. In situ grouting uses high-pressure jet grouting to form subsurface monoliths that can reduce water infiltration, stabilize contaminants, and provide additional ground stabilization to improve the long-term performance of a future cap. The actual grout used for in situ placement may be organic (e.g., paraffin, methacrylate, or styrene) or inorganic (e.g., phosphate-based, Portland cement-based, or silicate-based).

The project has two phases. Phase 1 will use in situ grouting to stabilize the corrosion of beryllium reflector blocks containing C-14, and Phase 2 will use this method of stabilization in other parts of the Subsurface Disposal Area to immobilize fission and activation products. Together, these two phases will mitigate the most imminent risk to human health, reducing migration to the Snake River Plain Aquifer from the Subsurface Disposal Area. Phase 1 is planned to begin in Fiscal Year 2004 and will achieve significant risk reduction within the fiscal year. Phase 2, which also begins in FY 2004, will use the experience of Phase 1 to reduce risk further for a larger part of the Subsurface Disposal Area.

EXECUTIVE SUMMARY

This mission need statement focuses on early action (i.e., action that can be initiated before the record of decision) and on continuing remedial action to reduce near-term risk by using in situ grouting[a] (ISG) to stabilize fission and activation (FA) products at the Subsurface Disposal Area (SDA). The SDA is a radioactive waste landfill located in the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory (INEEL) in southeastern Idaho. The *Second Revision to the Scope of Work for the Operable Unit 7-13/14 Waste Area Group 7 Comprehensive Remedial Investigation/Feasibility Study* recommends ISG for mitigating the near-term risk posed by areas containing FA products (Holdren and Broomfield 2003).

Field-monitoring data and modeling of contaminant fate and transport suggest that release and migration of mobile, long-lived FA products, including C-14 and Tc-99, pose the most immediate health risk from the SDA according to the *Ancillary Basis for Risk Analysis of the Subsurface Disposal Area* (Holdren et al. 2002). The risk can be greatly reduced by acting early to stabilize this waste using ISG and other actions to reduce infiltration.

Early action using ISG allows:

- Greatly reducing near-term human health risk by reducing further release and migration of FA products—the most immediate risk to human health from the SDA

- Fostering public faith in the intention and ability of the U.S. Department of Energy (DOE) to remediate the SDA

- Establishing experience for possibly using the grouting technology to remediate other waste forms at the SDA, including potentially all or part of Rocky Flats Plant (RFP) transuranic (TRU) waste, if ISG becomes part of the remedial action in the record of decision for Operable Unit (OU) 7-13/14.

The OU 7-13/14 ISG Project uses a two-phase approach:

1. Phase 1 stabilizes release of C-14 from beryllium reflector blocks buried in soil vaults and trenches. Conventional ISG technology will inject grout to encapsulate the blocks and minimize the infiltration of water to reduce both corrosion of the blocks and migration of contaminants from the blocks.

2. Phase 2 focuses on grouting larger areas in the SDA to stabilize FA products and other waste, including non-RFP-TRU waste, that are dispersed in SDA pits, soil vaults, and trenches, or to stabilize the ground to improve long-term performance of a future surface barrier cap.

While the scope of this project does not include RFP-TRU waste, it is possible that with the experience and lessons learned from Phases 1 and 2, a third phase could conceivably address RFP-TRU waste very effectively.

The process for developing the technical strategy for Phases 1 and 2 includes identifying programmatic and technical risks and establishing mitigation strategies for handling these risks and for subsequently monitoring the risks. The project will have a bias toward engineering flexibility to include

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a. The actual grout used for in situ placement may be organic (e.g., paraffin, methacrylate, or styrene) or inorganic (e.g., phosphate-based, Portland cement-based, or silicate-based).

the potential for grouting RFP-TRU in case this technology becomes part of the remedial action in the record of decision for OU 7-13/14.

This application of ISG supports DOE's complex-wide, accelerated approach to remediate facilities owned by the U.S. Department of Energy Environmental Management (DOE-EM) to reduce risk to human health and the environment. This complex-wide approach resulted from a DOE-EM top-to-bottom review of its cleanup program in Fiscal Year 2002 concluding that significant change was required in DOE's approach to risk reduction. This project reflects that change and offers the opportunity to make a significant contribution to greatly reducing the most imminent risk from the SDA.

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ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy Environmental Management
EPA	U.S. Environmental Protection Agency
FA	fission and activation
FFA/CO	Federal Facility Agreement and Consent Order
FY	fiscal year
ICDF	INEEL CERCLA Disposal Facility
ICP	Idaho Completion Project
IDEQ	Idaho Department of Environmental Quality
INEEL	Idaho National Engineering and Environmental Laboratory
ISG	in situ grouting
LCB	life cycle baseline
NCP	National Contingency Plan
NE-ID	U. S. Department of Energy, Idaho Operations Office
NTCRA	non-time-critical removal action
OU	operable unit
RFP	Rocky Flats Plant
RI/FS	remediation investigation and feasibility study
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
TRU	transuranic
WAG	waste area group
WBS	work breakdown structure

Mission Need Statement for the OU 7-13/14 ISG Project

1. INTRODUCTION

This mission need statement focuses on early action (i.e., action that can be initiated before the record of decision) and continuing action to reduce near-term risk by using in situ grouting[b] (ISG) to stabilize fission and activation (FA) products at the Subsurface Disposal Area (SDA). The SDA is a radioactive waste landfill located in the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering and Environmental Laboratory (INEEL) in southeastern Idaho (see Figure 1). Remedial actions using ISG for mitigating the near-term risk posed by areas containing FA products are recommended in both the *Second Revision to the Scope of Work for the Operable Unit 7-13/14 Waste Area Group 7 Comprehensive Remedial Investigation/Feasibility Study* (Holdren and Broomfield 2003) and the *Preliminary Evaluation of Remedial Alternatives for the Subsurface Disposal Area* (Zitnik et al. 2002).

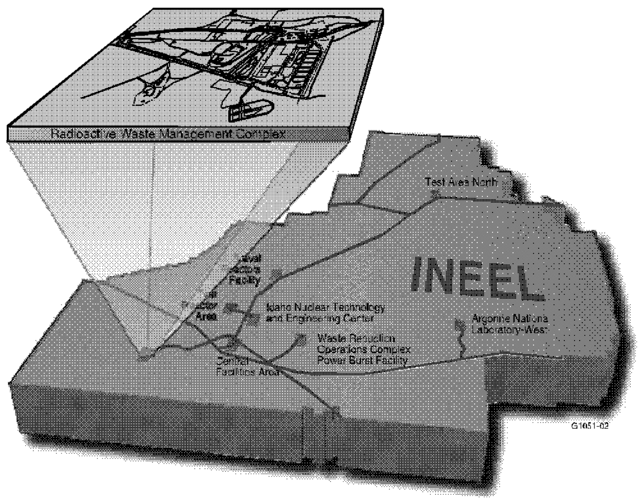

Figure 1. The Radioactive Waste Management Complex is located in the southwestern portion of the Idaho National Engineering and Environmental Laboratory.

Both field monitoring data and modeling of contaminant fate and transport suggest that mobile, long-lived FA products (e.g., C-14 and Tc-99) pose the most immediate health risks from the SDA according to the Ancillary Basis for Risk Analysis at the Subsurface Disposal Area (Holdren et al. 2002). The risk can be greatly reduced by acting early to stabilize these contaminants of concern (COCs) using ISG and other actions that reduce infiltration.

Early action using ISG allows:

- Greatly reducing near-term human health risk by reducing further migration of FA products—the most immediate risk from the SDA
- Fostering the public's faith in the intention and ability of the U.S. Department of Energy (DOE) to remediate the SDA
- Establishing experience for potentially using the grouting technology to remediate all or part of Rocky Flats Plant[c] (RFP) transuranic (TRU) waste if ISG becomes part of the remedial action in the record of decision for Operable Unit (OU) 7-13/14.

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b. The actual grout used for in situ placement may be organic (e.g., paraffin, methacrylate, or styrene) or inorganic (e.g., phosphate-based, Portland cement-based, or silicate-based).

c. The Rocky Flats Plant is located 26 km (16 mi) northwest of Denver. In the mid-1990s, it was renamed Rocky Flats Environmental Technology Site. In the late 1990s, it was again renamed, to its present name, Rocky Flats Plant Closure Project.

In situ grouting supports the Idaho Completion Project (ICP) purpose of reducing or eliminating risk posed by contamination and waste left at the INEEL from past missions, while protecting our workers, the public, and future generations.

1.1 History and Overview

Contaminants in the SDA landfill include TRU waste resulting from weapons manufactured at RFP, FA products and other waste resulting from on and offsite reactor operations and other sources, and hazardous chemicals associated with all waste sources. Plans for comprehensive remediation of the SDA are currently being developed; preliminary evaluation of assembled alternatives for remediation of the SDA has identified high-pressure jet grouting as a technology that can be effective for (1) in situ stabilization of FA products, (2) in situ stabilization of RFP-TRU waste, and (3) ground modification to provide a foundation for a surface barrier cap (Zitnik et al. 2002).

Although the scope of this project does not include RFP-TRU, if the final record of decision for the SDA identifies ISG as a remedial action, then this project will have provided valuable experience that could support a third phase and would accelerate use of ISG in areas containing RFP-TRU waste.

1.2 Regulatory Drivers for Remediation of the Subsurface Disposal Area

Federal statutes, agreements, and enforceable deadlines drive remediation of the SDA and are the legal basis for remedial actions. The INEEL was added to the U.S. Environmental Protection Agency (EPA) "National Priorities List of Uncontrolled Hazardous Waste Sites; Final Rule" (54 FR 48184, 1989) under the "Comprehensive Environmental Response, Compensation and Liability Act of 1980" (CERCLA/Superfund) (42 USC § 9601 et seq., 1980). The *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (FFA/CO) (DOE-ID 1991) established the procedural framework for identifying appropriate actions that must be implemented to protect human health and the environment at the INEEL in accordance with the following:

- "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP) (40 CFR 300)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601 et seq., 1980)
- "Resource Conservation and Recovery Act" (42 USC § 6901 et seq., 1976)
- "Idaho Hazardous Waste Management Act of 1983" (Idaho Code § 39-4401 et seq., 1983).

The action plan attached to the FFA/CO (DOE-ID 1991) includes the original schedule for developing, prioritizing, implementing, and monitoring response actions. The action plan provides for remediation of RWMC under the designation of Waste Area Group (WAG) 7.[d] Overall remediation of the SDA within RWMC is currently being evaluated through a comprehensive CERCLA remedial investigation and feasibility study (RI/FS) under OU 7-13/14. Ultimately the RI/FS will lead to risk

d. When the FFA/CO identified 10 WAGs for the INEEL, RWMC was identified as WAG 7. Each WAG was then subdivided into operable units. Fourteen OUs were identified at RWMC for investigation of actual and potential releases of hazardous substances. Operable Unit 7-13/14 is the combined OU 7-13 (remediation of pits and trenches) and OU 7-14 (comprehensive RI/FS) for WAG 7.

management decisions and selection of a final comprehensive remedial approach through development of a CERCLA record of decision.

Early application of ISG in this project supports the CERCLA evaluation and decision-making process by reducing risks associated with mobile COCs in the SDA inventory and by providing other technical data important to the feasibility study. Performance of the early ISG activities as non-time-critical removal actions (NTCRA) is appropriate based on review of NCP (40 CFR 300.415(b)(2)). Performance of the early actions as a NTCRA is also consistent with the DOE accelerated cleanup objectives (DOE-ID 2002b) as well as the objectives of the EPA Superfund Accelerated Cleanup Model. To implement the NTCRA, the project will adhere to requirements of the NCP and relevant EPA guidance documents (e.g., by preparing an engineering evaluation and cost analysis, conducting required public involvement activities, and documenting the approach in an action memorandum).

1.3 Supporting the U.S. Department of Energy Environmental Management Mission

This early application of ISG supports the DOE complex-wide, accelerated cleanup approach to remediate facilities owned by the U.S. Department of Energy Environmental Management (DOE-EM) to reduce risk to human health and the environment. This complex-wide approach resulted from a DOE-EM top-to-bottom review of its cleanup program in Fiscal Year (FY) 2002 that concluded significant change was required in the DOE approach to risk reduction (DOE 2002).

To that end, the U.S. Department of Energy, Idaho Operations Office (NE-ID) and the INEEL prime contractor met with the Idaho Department of Environmental Quality (IDEQ) and EPA, Region 10 (i.e., the agencies), to discuss an approach to INEEL accelerated cleanup. A letter of intent signed by the agencies in May 2002 (DOE-ID 2002a) documents their intention to pursue accelerated risk reduction and cleanup at the INEEL and establishes a focused vision for early action strategies. The ISG Project supports the *Environmental Management Performance Management Plan for Accelerating Cleanup of the Idaho National Engineering and Environmental Laboratory* (DOE-ID 2002b) to accelerate ICP activities. Figure 2 illustrates the interconnection of the May 2002 Letter of Intent and this project.

Nine strategic initiatives to accelerate cleanup of the INEEL, including "remediate buried waste at the Radioactive Waste Management Complex," are described in the EM Performance Management Plan (DOE-ID 2002b). The overarching goals of this plan are to (1) achieve significant risk reduction by FY 2012, (2) complete all active cleanup by FY 2020, and (3) further accelerate cleanup to allow completion by FY 2016. In situ grouting—a component of remediation for RWMC to "physically stabilize buried waste and contaminated soil, encapsulate and stabilize contaminants, and reduce movement of water through the waste zone"—is identified in the "Risk-Based End State for the Idaho National Engineering and Environmental Laboratory."[e]

The early action recommended by the OU 7-13/14 ISG Project—using ISG to stabilize FA products within the SDA and reduce near-term risk—is consistent with the May 2002 Letter of Intent to pursue accelerated risk reduction and cleanup at the INEEL Site. The early action builds on the need to reduce the risk of contaminating the Snake River Plain Aquifer and to protect human health and the environment. This early action does not preclude and is consistent with the final remedy for the SDA (Holdren and Broomfield 2003).

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e. DOE, 2003, "Risk-Based End State for the Idaho National Engineering and Environmental Laboratory (Draft)," DOE/ID-11110, Rev. C, U.S. Department of Energy Idaho Operations Office, December 2003.

1.4 Path Forward for In Situ Grouting: Early Stabilization of Fission and Activation Products

Previous INEEL studies and demonstrations (see Appendix A) show that ISG is an effective and implementable technology for in situ stabilization of FA products (Loomis and Thompson 1995; Loomis, Thompson, and Heiser 1995; Loomis, Zdinak, and Bishop 1996; Loomis et al. 2002). To minimize the risk of mobilizing contaminants within the waste zone, the INEEL has chosen a single-phase, nondisplacement, jet-grouting approach that does not require injection of high-pressure air or free water. This approach includes driving a drill stem to the bottom of the waste zone, then injecting grout at high pressure[f] as the drill stem is removed. During this process, excess grout may be returned to the surface along the outside of the drill stem. Single-phase grouting in the dense surficial soil of the INEEL results in emplacement of grout columns approximately 2 ft in diameter. The objective of using ISG is to encapsulate buried waste in contiguous grout columns to form stabilized waste monoliths. To accomplish this objective, grout columns must be repeatedly and efficiently placed.

The OU 7-13/14 ISG Project uses a two-phase approach. Phase 1 stabilizes C-14 migrating from beryllium reflector blocks (i.e., TRU generated at INEEL) buried in soil vaults and trenches. Conventional ISG technology will be used to inject grout to minimize infiltration of water both to reduce corrosion of the blocks and to reduce migration of contaminants from the blocks. See Figure 3 for an illustration of grouting beryllium reflector blocks in Phase 1.

Phase 2 focuses on grouting larger areas in the SDA to stabilize FA products, including C-14 and Tc-99, dispersed in the SDA or to stabilize the ground to improve long-term performance of a future surface barrier cap. While conventional ISG approaches may be applicable to stabilizing specific, localized contaminants (e.g., those

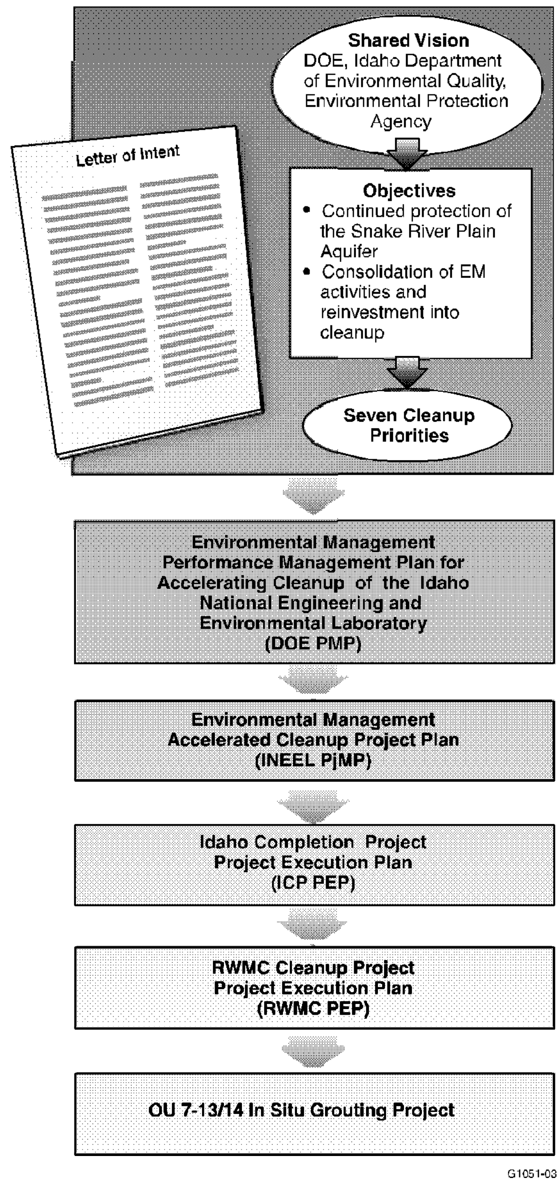

Figure 2. Interconnection of the OU 7-13/14 In Situ Grouting Project with the Environmental Management Performance Management Plan to support acceleration of Idaho Completion Project activities.

f. The actual grout used for in situ placement may be organic (e.g., paraffin, methacrylate, or styrene) or inorganic (e.g., phosphate-based, Portland cement-based, or silicate-based). While a paraffin grout can be injected at a lower pressure than a cementitious grout, all jet grouting requires relatively high pressure for injection.

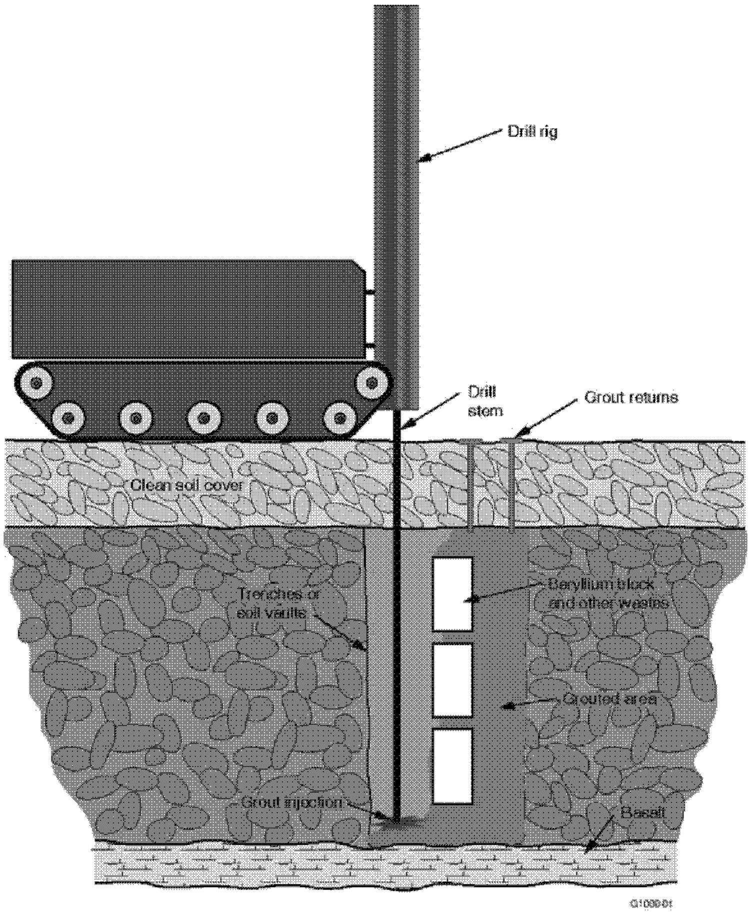

Figure 3. Illustration of grouting of beryllium reflector blocks in Phase 1.

released from the beryllium reflector blocks), these methods would not provide the productivity required for remediation of large areas containing FA products or RFP-TRU buried waste.

The ISG Phase 2 system for grout emplacement will increase productivity by (1) automating drill rig positioning and subsequent grout emplacement, (2) removing the need for a thrust block[g] to contain grout returns, and (3) reducing direct operator contact with grout emplacement equipment and potentially contaminated grout returns. In addition, increased precision, flexibility, and repeatability of grout emplacement using the Phase 2 system will ensure high-quality, stabilized waste monoliths in the highly heterogeneous waste forms and produce experience and lessons learned for a flexible approach to a possible third phase to grout other waste, including RFP-TRU. ISG allows the choice of partially retrieving waste if necessary, yet grouting the remainder of waste for which ISG is appropriate.

g. Some conventional grouting methods previously used at INEEL (see Appendix A) have deployed a thrust block to prevent potential contamination of the equipment and operator from grout returns brought to the ground surface.

2. ANALYSIS TO SUPPORT THE MISSION NEED

The Ancillary Basis for Risk Analysis (ABRA) (Holdren et al. 2002) estimated cumulative human health and ecological risks from the SDA, and the Preliminary Evaluation of Remedial Alternatives (PERA) (Zitnik et al. 2002) evaluated alternatives for remediating the SDA.

2.1 Ancillary Basis for Risk Analysis

The ABRA evaluated radionuclide and chemical COCs disposed of in the SDA. Modeling of contaminant fate and transport included in this study suggests that non-TRU COCs (specifically FA products) pose the most imminent risk to human health from waste disposed of in the SDA, as depicted in Figure 4. Note that non-TRU COCs (shown in black) closely shadow total risk (green). Furthermore, field monitoring data suggest that C-14, I-129, and Tc-99 are migrating from the buried waste zone (Holdren et al. 2002).

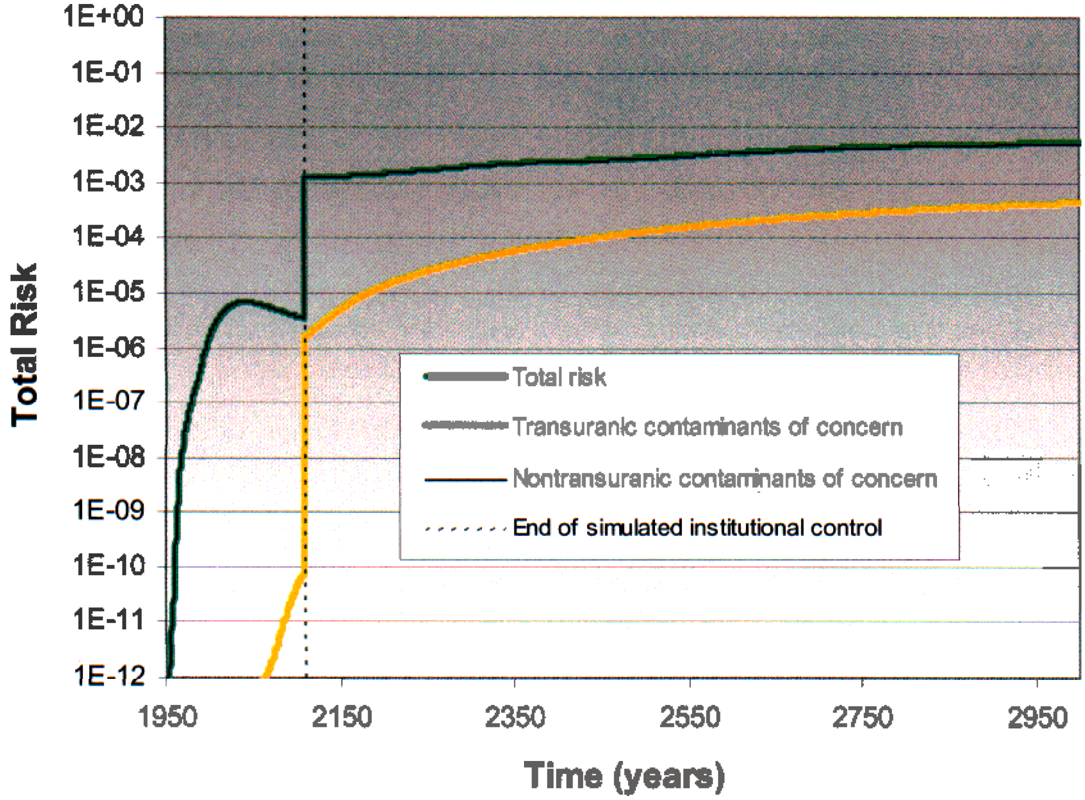

Figure 4. Chart showing that nontransuranic contaminants of concern pose the most imminent risk to human health from waste disposed of in the Subsurface Disposal Area.

Evaluation of the nature and extent of contamination concludes that low concentrations of C-14 are affecting the aquifer near the SDA. Iodine-129 and Tc-99 have not affected groundwater quality, but have been detected at low concentrations in the vadose zone and may be migrating.

Carbon-14 and Tc-99 are among the most frequently detected contaminants in the vadose zone. Iodine-129 is detected sporadically at concentrations near detection limits.

Risk estimates for the future residential exposure scenario exceed 1E-05 for 17 contaminants. A hazard index greater than or equal to 1 is identified for three contaminants. The groundwater ingestion pathway risk is greater than or equal to 1E-04 for seven radioisotopes, including C-14 and Tc-99. Carcinogenic risks between 1E-05 and 1E-04 were estimated for I-129 for the groundwater ingestion pathway. The estimated total risks for five of the 17 contaminants for a future residential scenario (vertical dotted line in Figures 4 and 5) are depicted in Figure 5.

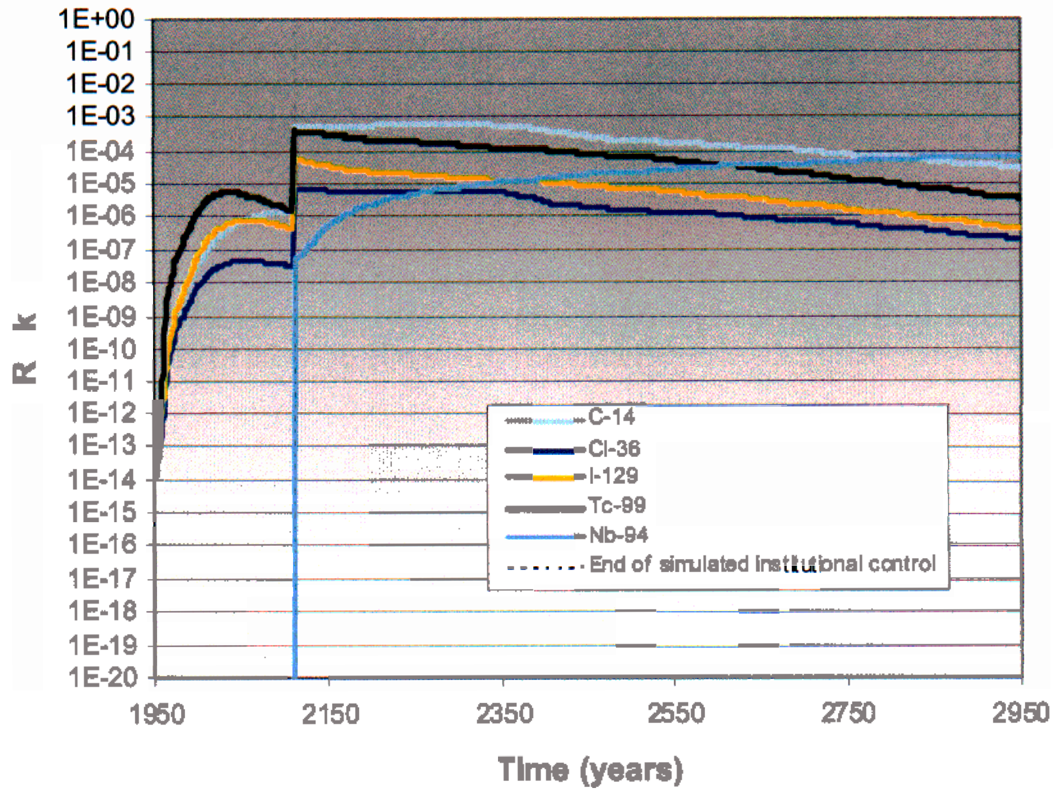

Figure 5. Chart displaying estimated total risk for five of the 17 contaminants for a future residential scenario.

Approximately 19% of the C-14 inventory in the SDA is associated with beryllium reflector blocks (i.e., TRU generated at the INEEL). The remainder of the C-14 inventory is in other activated metals. The inventory associated with the beryllium reflector blocks is of particular concern because of the higher corrosion rate of beryllium in the SDA environment (i.e., corrosion rates are approximately two orders of magnitude higher). Therefore, Phase 1 of the OU 7-13/14 ISG Project focuses on controlling C-14 releases from the beryllium reflector blocks. Phase 2 addresses source term control of more widely dispersed waste forms associated with disposals of FA products. In addition, modeling of uranium isotopes indicates risk exceeding 1E-05. This project will also evaluate ISG for uranium COCs.

2.2 Preliminary Evaluation of Remedial Alternatives

Both the PERA and the *Second Revision to the Scope of Work for the Operable Unit 7-13/14 Waste Area Group 7 Comprehensive Remedial Investigation/Feasibility Study* (Holdren and Broomfield 2003) identify ISG as an alternative, focusing on in situ stabilization of COCs with the potential for migration to the vadose zone. The PERA states that ISG "has been shown to be highly effective in immobilizing a wide range of contaminants and will adequately address the majority of waste streams identified in the SDA" (Zitnik et al. 2002). In situ grouting also is identified as a component of each of the assembled alternatives to immobilize FA products and provide a stable foundation for the barrier cap.

The PERA also identifies the effect of time on the magnitude of the potential vadose zone contamination. If early action is taken to reduce release and stabilize migration of C-14 and Tc-99, future effects on area groundwater could be greatly reduced. Because the migration of contaminants suggested by field monitoring data has been slower than predicted, the opportunity is available to use ISG to stabilize this migration before contaminants begin to move beyond the reach of ISG as a remedial alternative.

3. IMPORTANCE OF MISSION NEED AND IMPACT IF NOT APPROVED

This section describes the benefits of the OU 7-13/14 ISG Project and the consequences if it is not implemented.

3.1 Importance of Mission Need

The importance of this mission can hardly be overstated. Stabilizing C-14 as addressed in Phase 1 greatly reduces the near-term risk to human health from the SDA. Phase 2 stabilizes FA products in pits, soil vaults, and trenches. If approved, the early and continuing actions will:

- Eliminate a large percentage of the immediate risk to human health from the SDA
- Supply proof for state officials and the public that the SDA can be remediated and proof that DOE is willing and intends to do so
- Begin a significant risk reduction activity at the SDA within 1 year
- Offer preliminary experience, training, and equipment that will be applied if the record of decision identifies ISG for remediating waste in other areas of the SDA
- Offer experience that can be used also by the greater DOE complex.

3.2 Impact if Not Approved

Impacts if the early and continuing actions are not approved:

- The major effect is the continuing migration of FA products from the SDA into the vadose zone and threat to the Snake River Plain Aquifer
- A secondary effect is that eventual application of ISG technology will be slower, and stabilization of other contaminants also will be slower because of the lack of experience and training provided by this early action
- Public perception that remediation is not going forward will continue.

4. WORK SCOPE, RISKS, CONSTRAINTS, AND ASSUMPTIONS

The OU 7-13/14 ISG Project will provide grouting of non-RFP-TRU waste, as is compatible with and common to all action-alternatives proposed in the *Second Revision to the Scope of Work for the Operable Unit 7-13/14 Waste Area Group 7 Comprehensive Remedial Investigation/Feasibility Study* (Holdren and Broomfield 2003). The project will be implemented in two phases to enable an early start on field work. Lessons learned from early implementation of Phase 1 will be used to refine the later system design and operability of Phase 2. Phase 2 design will include a clear bias toward engineering flexibility to allow its use in grouting other areas that include uranium and RFP-TRU in a potential third phase.

This section addresses the work scope of Phases 1 and 2 and associated project risks, constraints, and assumptions.

4.1 Work Scope

Work will be conducted in accordance with applicable DOE and INEEL requirements, which will be specified in the Project Execution Plan and other appropriate documents.

4.1.1 Phase 1: In Situ Grouting Early Action

Phase 1 consists of the following major activities and supporting documentation (i.e., safety basis, quality, and regulatory):

1. Procuring qualified vendor(s) to perform field activities associated with stabilization of beryllium reflector blocks in the SDA

2. Obtaining grouting material

3. Installing grout around the beryllium reflector blocks in soil vaults and trenches

4. Installing the field-monitoring system to monitor effectiveness of the grout.

4.1.2 Phase 2: Balance of In Situ Grouting Early Action

Phase 2 of the project consists of the following major activities:

1. Developing the conceptual design for stabilizing FA products (other than the beryllium reflector blocks in Phase 1) in the balance of SDA pits, trenches, and soil vaults, including

    - Determining the extent that grouting is deployed to support ground stabilization for better performance of the future barrier cap

    - Engineering the flexibility, if possible, to allow potential use of this equipment in stabilizing RFP-TRU

2. Procuring qualified vendor(s) for design, fabrication, and field installation activities

3. Obtaining grout

4. Installing grout in pits, soil vaults, and trenches as determined during conceptual design.

4.2 Project Risk

The objective of the process for managing project risk is to manage project uncertainty by reducing or eliminating risk. Uncertainty, in this context, is the lack of absolute knowledge or predictability about the outcome of a future event, about the likelihood of its occurrence, or about its consequences.

The project will use a continuous risk management process consisting of these steps: identify, analyze, plan, track, and control.

The project plans to reduce the probability that the risk will occur. Risks with the highest initial risk scores and their associated risk-reduction strategies are summarized in Table 1.

Table 1. Summary of risks with highest initial risk scores and the associated risk-reduction strategy.

Risk	Risk-Reduction Strategy
If a graded approach is not used to achieve the following, then it is possible that the schedule will not be met for Phases 1 or 2.	
1. Simplify the requirements to perform work at the SDA.	1. Engage upper management in the issues so that the project's success or failure will have their management interest.
2. Determine work control processes in terms of the risk posed by the phase and activity.	2. Define and establish graded approach work control requirements in project execution plans and safety documentation.
3. Manage the drive to use overly conservative assumptions and design requirements generated by uncertainty of the source term.	3. Document in the project execution plan and the safety documentation a design for conditions expected and contingency plans for the unexpected.
If a significant environmental release occurs or if a significant work exposure occurs, Phase 1 will probably be stopped.	Use continuous air monitors, local air venting, and personal lapel monitors to provide early warning of release (e.g., tritium).
If NE-ID management or ICP upper management overturn the decision to classify grouting the beryllium reflector blocks as less than Hazard Category 3, the schedule for Phase 1 probably will not be met.	The project will continue to provide justification for less than Hazard Category 3.
If the project is unable to demonstrate that all lessons learned from the 2001 ISG accident have been incorporated into the planning, design, and operation of the project, it is probable that Phases 1 and 2 will not continue.	The project will formally address the lessons learned in the project risk assessment documents for Phases 1 and 2.
If no qualified vendors are willing to negotiate the contract, it is probable that project objectives for Phases 1 and 2 will not be met.	Project management has published a "Request for Expressions of Interest" in "Federal Business Opportunities"[a] to evaluate this risk for Phase 1; Phase 1 experience will help in preparing a formal acquisition plan for Phase 2.

Table 1. (continued).

Risk	Risk-Reduction Strategy
If INEEL physical resources or an adequate and timely labor force are preempted by higher priority operational activities or are not available, it is probable that the schedule for Phase 1 will not be met.	Project management will continually check the relative priority of resources and the resource profiles for concurrent projects.

a. FBO, 2003, "Federal Business Opportunities," URL: http://www.fedbizopps.gov/.

ICP = Idaho Completion Project
INEEL = Idaho National Engineering and Environmental Laboratory
NE-ID = U.S. Department of Energy, Idaho Operations Office
SDA = Subsurface Disposal Area

4.3 Project Constraints

The PERA provides a detailed analysis and comparison of alternate technologies with ISG. Both the PERA and the *Second Revision to the Scope of Work for the Operable Unit 7-13/14 Waste Area Group 7 Comprehensive Remedial Investigation/Feasibility Study* (Holdren and Broomfield 2003) recommend using ISG in the SDA. Major constraints of the OU 7-13/14 ISG Project include the following:

- Location of the beryllium reflector blocks in the SDA
- The SDA is a landfill for radioactive waste and hazardous waste
- Timing of other remediation activities (e.g., contour grading and increasing the depth of the overburden to reduce infiltration) may constrain schedule coordination and increase depth to be grouted.
- Availability of grouting contractors willing to bid a DOE site for work with a radiological environment.

4.4 Project Assumptions

The objective of the process for managing project assumptions is to continue defining, clarifying, and quantifying assumptions until they become requirements. Initially, the following areas are being addressed.

4.4.1 Operational Limitations

Assumptions addressing operational limitations in effectiveness, capacity, technology, organization, or other special considerations are listed below:

- Phase 1
  - Waste addressed in this phase is beryllium reflector blocks (i.e., TRU waste generated at the INEEL).
  - Work activities will be classified for safety analysis purposes as nonnuclear (less than Hazard Category 3)

  - Hazards will be managed using current controls and programs, particularly the radiation protection program, and no new safety documents will be prepared.
  - For the purposes of the safety analysis, the project will be segmented from the rest of the RWMC.
- Phase 2
  - Areas addressed in this phase may include some non-RFP transuranic waste.
- Phases 1 and 2
  - Experience using ISG at the INEEL and the SDA in the past will be adequate to address the risks of this technology
  - A median-cost grout will be selected and used
  - In situ grouting is a routine construction practice and will not require additional documents and procedures beyond those normally required.

4.4.2 Organization, Geographic, and Environmental

Organization, geographic, and environmental assumptions are listed below:

- Phase 1
  - Fourteen locations of beryllium reflector blocks will be grouted
- Phases 1 and 2
  - No physical impediments will be encountered to preclude grout injection
  - Closure of the SDA due to subsidence or other reasons will not affect the schedule
  - Weather-related shutdowns will be minimal.

4.4.3 Standardization and Standards

Assumptions about standardization and standards are listed below:

- Phases 1 and 2
  - Design of the ISG system will be constrained by various laws, regulations, DOE orders, and national and international codes and standards
  - Grout will be nondisplacement, pressure-injected by a subcontractor experienced with this technique
  - Grout will be installed using the subcontractor's equipment and in accordance with the subcontractor procedures
  - Grouting equipment will be operated by qualified personnel provided by the subcontractor

- All procured services and materials will be consumer grade.

4.4.4 Environmental, Safety, and Health

Environmental, safety, and health assumptions are listed below:

- Phase 1
  - The Radiological Controls organization will not require a containment structure or a thrust block
  - Operating personnel will be required to wear some level of radiological personal protective equipment
  - Beryllium-isolation NTCRA activities will generate minimal radioactive waste (e.g., potentially contaminated grout returns)
  - No conduct-of-operations matrix will be required
  - No new fire hazard analysis will be required
  - No new preincident plan will be required
  - No new criticality concerns will be raised
  - No additional technical safety requirements will be required.
- Phase 2
  - The grout will provide primary containment of material at risk
  - A minimal soil cover to prevent freeze-thaw cycling of grouted areas will be compatible with future SDA comprehensive capping strategies
  - This ISG remedial action will be compatible with current and future SDA remedial actions.

4.4.5 Safeguards and Security

Safeguards and security assumptions include the following:

- Phases 1 and 2
  - No special safeguards and security requirements will be necessary
  - No buried classified material will be exposed.

4.4.6 Interfaces with Existing and Planned Acquisitions

Assumptions about interfaces with existing and planned acquisitions include the following:

- Phases 1 and 2
  - Post-removal site control—as required through CERCLA guidance—will be adequately addressed by current SDA controls, policies, procedures, and the record of decision.

4.4.7 Affordability Limits in Investment

Assumptions about technology development include the following:

- Phases 1 and 2
  - No technology development will be associated with the OU 7-13/14 ISG Project.

4.4.8 Goals for Limitations on Recurring or Operating Costs

Assumptions about goals for limitations on costs include the following:

- Phases 1 and 2
  - After the work is completed, subcontractors can retain the equipment because radiological contamination will not preclude releasing equipment from the INEEL.

4.4.9 Legal and Regulatory Constraints and Requirements

Assumptions about legal and regulation constraints and requirements include the following:

- Phases 1 and 2
  - The regulatory agencies (i.e., EPA and IDEQ) will support this early action, concur with the NTCRA approach, and not provide significant oversight, comments, or delays.
  - The ISG project will be conducted as a NTCRA
  - National Environmental Policy Act requirements will be addressed through the CERCLA process.

4.4.10 Stakeholder Considerations

Stakeholder considerations are assumed to include the following:

- Phases 1 and 2
  - Stakeholders (including NE-ID, IDEQ, EPA Region 10, Idaho congressional staff, Idaho state and local governments, Shoshone - Bannock Tribes, INEEL Citizens Advisory Board, and environmental advocacy groups [e.g., Coalition 21, Environmental Defense Initiative, INEEL Research Bureau, Keep Yellowstone Nuclear Free, and the Snake River Alliance]) will not present significant objections or delays.

4.4.11 Limitations

Limitations associated with program structure, competition and contracting, streamlining, and the use of development prototypes or demonstrations are assumed to include the following:

- Phases 1 and 2
  - Subcontractors will have acceptable quality assurance plans, safety plans, operating procedures, and training programs
  - Subcontractor plans and programs will be reviewed and approved during the procurement award and vendor data review processes
  - Cold (i.e., nonradioactive environment) demonstrations of grout equipment and procedures in a nonradioactive and nonhazardous environment will be necessary.

5. APPLICABLE CONDITIONS AND INTERFACES

The INEEL experience with jet grouting (including several tests and demonstrations over a period of 9 years; see Appendix A) indicates the following significant conditions and onsite project interfaces.

5.1 Significant Conditions

5.1.1 Operational Safety

The accident and resulting injury that occurred during the ISG demonstration in October 2001 strongly affected the current approach to this technology. The immediate cause of the accident was failure of a fitting under high pressure. The subcontract will be written to require certification at a specific pressure for all parts containing the grout to ensure that such failures do not occur. The certified level will be a specified amount above the pressure at which the grout is inserted, and multiple checks will be put in place to ensure that the correct equipment is being used. Additional safety measures can be implemented for a layered approach.

5.1.2 Choice of Grout

The choice of grout, whether cementitious or wax-based, will govern whether cost and competition become significant conditions. Because one company holds the patent for the preferred wax mix, using the wax-based material eliminates most competition in bidding the material supply. If cementitious grout is chosen, then more competition would be possible. The evaluation on which to base this decision is continuing.

5.1.3 Compatibility with Existing or Future Systems

There are no compatibility issues with systems presently at the INEEL. However, because ISG is part of all assembled alternatives for remediation of the SDA (Holdren and Broomfield 2003), planning will strongly consider the potential future use of the equipment in remediating other locations at the SDA. It is also possible that, with successful implementation at the INEEL, ISG will be a good choice for remediation at other locations in the DOE complex (e.g., Oak Ridge [Melton Valley] or Sandia National Laboratories). Using safety and operational procedures developed on this project, it will be easier and more cost-effective to use this technology at other sites.

5.2 On-Site Project Interfaces

5.2.1 Interfaces for Services Provided by the Idaho National Engineering and Environmental Laboratory

The ISG project will establish needed interfaces to obtain, at a minimum, the following INEEL-provided services:

- Maintenance coordination
- Financial operations
- Supply chain management
- Radiological controls

- Laboratory analysis support.

5.2.2 Interface with the Radioactive Waste Management Complex

Needed utilities (e.g., electrical power, fire protection, potable water, and sanitary sewer) as well as site access for grout equipment construction, installation, and operation will be negotiated with the RWMC project director and the RWMC project operations manager.

5.2.3 Interface with the Idaho National Engineering and Environmental Laboratory Comprehensive Environmental Response, Compensation, and Liability Act Disposal Facility

Disposition of ISG equipment and containment structures, as well as other secondary waste resulting from grouting processes, may use INEEL CERCLA Disposal Facility (ICDF) resources. During conceptual design, waste disposal options will be identified, the level of use of each option will be estimated, and interface with ICDF will be initiated based on that level of use.

6. RESOURCE REQUIREMENTS AND SCHEDULE

Life cycle baseline (LCB) planning for this project occurred during FY 2003 with assumed applicability of DOE Order 413.3, "Program and Project Management for the Acquisition of Capital Assets" (i.e., that LCB is the basis for the cost estimate and the Phase 2 schedule estimate presented below). Subsequently, it was determined that DOE Order 413.3 does not apply to parts of or to the entire project. Thus the cost will be less than the LCB-based estimate.

Success of Phases 1 and 2 depends on the award of subcontracts to vendors experienced with injection grouting of waste.

6.1 Project Schedule

The ISG project LCB was estimated in FY 2003 in accordance with the INEEL accelerated cleanup schedule in the EM Performance Management Plan (DOE-ID 2002b). Subsequently, to further accelerate cleanup of FA products, project work was divided into two phases. Phase 1, ISG Early Action, will start grouting the beryllium reflector blocks in FY 2004, while the balance of the early-action ISG work (Phase 2, Balance of ISG Early Action) will meet or improve on the LCB schedule.

Implementing Phase 1 in FY 2004 requires an aggressive approach to produce a technical and acquisition strategy that requires minimal design or construction of facilities. The schedule for completing Phase 1 depends on the hazards analysis that will be performed, and on the level of autonomy allowed or control imposed on the subcontractor. Assuming a hazard category less than 3, the resulting project schedule identifies key target dates to achieve startup in FY 2004 and complete processing operations in FY 2005. A timeline for the ISG project is shown in Figure 6.

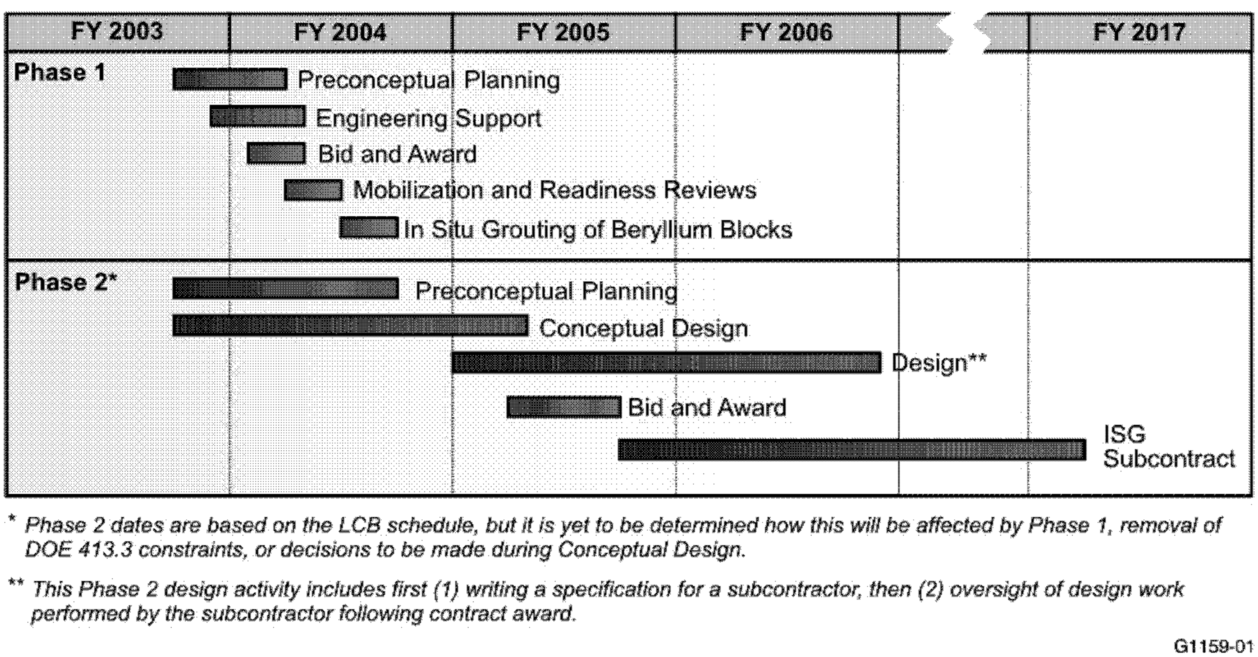

Figure 6. Timeline for the OU 7-13/14 In Situ Grouting Project.

6.1.1 Phase 1

Key target dates to achieve startup in FY 2004 and complete processing operations in FY 2005 include the following:

- Preconceptual planning—October 2003-March 2004
- Engineering support—December 2003-April 2004
- Bid and award—February-April 2004
- Mobilization and management self-assessments—April-June 2004
- In situ grouting of beryllium reflector blocks—July 2004-November 2004.

6.1.2 Phase 2

Phase 2 dates listed below are based on the LCB schedule. It is yet to be determined how these dates will be affected by (1) Phase 1 achievements, (2) removal of some or all DOE 413.3 constraints, or (3) decisions that will be made during conceptual design.

- Preconceptual planning—October 2003-September 2004
- Conceptual design—October 2003-April 2005
- Critical Decision (CD) -0/1 approval—January 2005
- Preliminary design—January 2005-November 2006
- Bid and award—April-September 2005
- CD-2/3 approval—January 2006
- In situ grouting subcontract—September 2005-March 2016.

6.2 Project Cost and Funding Profile

Decisions that have significant impacts on the total cost of the project include the following:

- Choice of grout material
- Total area to be grouted
- Spacing of grout injection points
- Availability of grouting subcontractors
- Applicability of DOE Order 413.3
- Legal decisions affecting volume of buried transuranic waste to be removed from the SDA.

Assuming a median-cost grout and conservative estimates for the other assumptions noted above, the LCB-estimated total project cost is $532 million as shown in Table 2. The grout formulation drives the LCB-estimated cost. Excluding the cost of the grout itself, the LCB cost estimate for the project is $215 million. This baseline estimate assumes injection of grout in SDA Trenches 16 through 58; Pits 7, 8, and 13 through 16; and Soil Vault Rows 1 through 21, up to a maximum total of 14 acres, with grout injection spaced 20 in. apart. The baseline estimate also assumes full applicability of DOE Order 413.3 to the project, which is now thought to be unnecessary. Removing applicability of this DOE order from the baseline is expected to reduce the project cost and schedule. The Phase 2 schedule dates listed above reflect the LCB estimate.

Table 2. Total project cost estimate (in thousands) of the life cycle baseline for the OU 7-13/14 In Situ Grouting Project (Phases 1 and 2).

	FY 2004[a] ($)	FY 2005 ($)	FY 2006 ($)	FY 2007 ($)	FY 2008 through FY 2016[b] ($)	Total ($)
Preconceptual planning	570					570
Conceptual design, review and approval, bid and award	1,065	3,082				4,147
Preliminary design and review and approval			1,003			1,003
ISG subcontract			56,000	50,000	398,500	504,500
ISG operating and management contractor			100	100	800	1,000
Construction management			980	980	7,840	9,800
Project management and project closeout	1,279	1,211	870	870	7,260	11,490
Total	2,914	4,293	58,953	51,950	414,400	531,940

a. Acceleration of Phase 1 work will move some costs forward into FY 2004.

b. Each year's cost for FY 2008 through FY 2015 is approximately the same as FY 2007, plus project closeout costs in FY 2016.

ISG = in situ grouting.

Phase 2 locations and the amount of grouting will be determined during conceptual design when the grout formula will be selected as well. The need for grouted structural supports for capping, and their expected amount and location, will also be determined during Phase 2 conceptual design. The cost estimate and schedule will be updated accordingly.

6.3 Measures to Determine Project Success

The project management team will effectively track scope, schedule, and cost performance using monitoring tools based on the work breakdown structure (WBS). The WBS will be developed to subdivide the total project into defined areas of work and then will be subdivided into successively lower levels of detail to the point where a work unit is manageable. Each work unit will contain one or more deliverables identified as needed to accomplish the work.

6.3.1 Phase 1

Phase 1 will include completion of the following milestones and deliverables:

- Finalize grout selection
- Choose bid process
- Determine performance specifications
- Award subcontract
- Complete equipment delivery onsite
- Obtain management approval to start operations
- Complete grouting of beryllium reflector blocks.

6.3.2 Phase 2

Phase 2 will include completion of the following milestones and deliverables:

- Mission need statement
- Conceptual design plan
- Acquisition plan
- Risk management plan
- Project execution plan
- Grout selection decision
- Conceptual design
- Bid and award Phase 2 design-and-build grout subcontract
- Preliminary design
- Final design
- Fabrication, construction, and installation, as needed
- Demonstrations, as needed
- Management approval to start operations
- Complete Phase 2 grouting.

Success in schedule and cost performance will be measured by progress against defined deliverables (e.g., those listed above). The project will use an earned value system to measure quantifiable work accomplishments with respect to the deliverables. Engineering and procurement deliverables (e.g., drawings, specifications, and material requisitions) will be tracked using this progress measurement technique, which will use identifiable trigger points. Trigger points will have an associated performance value or will be based on task completion. Level-of-effort tasks (i.e., those without deliverables) will be based on productive hours for the period as identified by fiscal year accounting calendars. Construction schedule progress will be determined based on unit quantities installed relative to the plan. Subcontract earned-value will be determined regularly to support management's reporting responsibilities.

Idaho Completion Project planning and controls will provide tools (e.g., unique charge numbers, spreadsheet rollups of actual costs, and earned value calculations) to monitor costs in alignment with the WBS and DOE requirements. Weekly, monthly, and year-to-date actual cost reports will be generated for both hours and dollars. Change control management and trend reporting will be used to report variances from the baseline-planned progress. Variances from planned schedule and cost performance will be reviewed and dispositioned by project management and documented monthly with corrective actions identified and implemented. Monthly estimates-at-completion will be developed based on actual performance and identified trends.

7. DEVELOPMENT PLAN

The effectiveness of ISG in remediating simulated waste has been successfully demonstrated at the INEEL several times in the past 9 years. Vendors have demonstrated ISG on nonradioactive waste using various grout formulas at the RWMC Cold Test Pit. In each test, the retrieved matrix of grouted surrogate waste revealed a high degree of grout penetration (see Appendix A).

The OU 7-13/14 ISG Project will use grouting information from the following documents. In addition, information in these documents will be used to determine the location of the beryllium reflector blocks and other planned locations for application of ISG technology within the SDA:

- Ancillary Basis for Risk Analysis (Holdren et al. 2002): a comprehensive study of source inventory and locations in the SDA

- Preliminary Evaluation of Remedial Alternatives (Zitnik et al. 2002): a comprehensive study of possible remedial alternatives

- Additional recent reassessments of source inventory in the SDA.[h,i]

The PERA evaluated available commercial technologies and capabilities as well as emerging technical approaches. Applicability and implementability of ISG to the SDA was determined using principles of value engineering, the engineering judgment of the team producing the PERA, criteria relating to protection of human health and the environment, and transferability of ISG to other SDA areas.

Since the LCB was estimated during FY 2003 assuming DOE Order 413.3 would apply to the project, it has since been determined that DOE Order 413.3 will not apply to the entire project. In addition, ISG of the beryllium reflector blocks (Phase 1) was accelerated to start in FY 2004, with the balance of ISG activities (Phase 2) expected to meet or improve the LCB cost and schedule estimate. During FY 2004, the effects of Phase 1 and removal of some or all DOE 413.3 constraints will be determined, and the schedule and cost estimate accuracy will be improved because of Phase 2 conceptual design. During Phase 2 conceptual design, evaluation and decisions also will be made on the following:

- Grout formula
- Grout locations
- Whether and what structural support is needed for surface barrier caps
- Whether and what equipment changes will allow flexibility and potential for grouting RFP-TRU
- Acquisition plans (the LCB estimate assumes a design/build subcontract)
- Definition of hazard category for remedial actions in both FA and TRU areas
- Form of radiological confinement or containment.

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h. Carboneau, Michael L., and James A. Vail, 2003, “Estimated Radiological Inventory from Argonne National Laboratory-West at OU 7-13/14,” Draft 2, December 2003.

i. Vail, James A., Michael L. Carboneau, and Glen L. Longhurst, 2003, “Estimated Radiological Inventory Sent from the Idaho Nuclear Technology and Engineering Center to the Subsurface Disposal Area from 1952 through 1993 (Draft),” Draft, December 2003.

8. SUMMARY

Approval of this mission need statement for the OU 7-13/14 ISG Project is the critical first step in reducing the migration of FA products from the SDA into the Snake River Plain Aquifer. This project allows DOE to:

- Greatly reduce near-term human health risk by reducing further migration of FA products—the most immediate risk from the SDA
- Foster public faith in the intention and ability of DOE to remediate the site
- Establish experience for potentially using the grouting technology to remediate RFP-TRU waste.

The action proposed in this document will undergo further evaluation and development to establish the most cost-effective and action-efficient way to acquire and use this technology safely. Such evaluation and development are currently proceeding in support of Phase 1.

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42 USC § 6901 et seq., 1976, "Resource Conservation and Recovery Act of 1976 (Solid Waste Disposal Act)," *United States Code.*

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Appendix A

Brief History of In Situ Grouting at the Idaho National Engineering and Environmental Laboratory

Appendix A

Brief History of In Situ Grouting at the Idaho National Engineering and Environmental Laboratory

Jet grouting has been successfully demonstrated throughout the nation for at least 20 years, particularly in the oil industry and dam projects and for civil engineering projects (e.g., footings for bridges and buildings). The history of in situ grouting (ISG) demonstrations and tests at the Idaho National Engineering and Environmental Laboratory (INEEL) is described below.

The 1994 test demonstrated ISG technology and evaluated the capability to contain contaminant spread using simulated Rocky Flats Plant transuranic (TRU) waste buried in shallow landfill pits. A lance injection system was used for in situ low-pressure injection in one of the test pits (Loomis, Thompson, and Heiser 1995).

The second 1994 test demonstrated high-pressure jet grouting technology (using BRISTAR as a demolition grout) and remote retrieval (i.e., using a remote-operated backhoe) of simulated TRU waste (Loomis and Thompson 1995).

The 1995 test demonstrated jet grouting with four proprietary grout materials and one commercially available grout. The commercial grout was Type-H high sulfate-resistant cement. The four proprietary grouts were a water-based epoxy; an INEEL-developed, two-component grout; a molten, low-temperature paraffin; and a proprietary, iron oxide cement-based grout known as TECT (Loomis, Zdinak, and Bishop 1996).

The 1997 test demonstrated ISG using simulated waste in the Acid Pit. A series of grout injections through the thrust block into disturbed soil produced a large monolith. The large monolith was removed intact as a unit with a front-end loader for further examination (Loomis et al. 1998a).

The second 1997 demonstration of ISG was the first radiologically hot use of ISG technology at the INEEL and took place at the RWMC Acid Pit. Subsequent coring of the remediated pit showed successful permeation of grout into the soil and waste (Loomis et al. 1998b).

In 2001, ISG was also demonstrated on simulated waste at the INEEL Cold Test Pit where a cementitious grout was shown to be successful in forming columns in INEEL soil and in permeating simulated waste forms (Loomis et al. 2002). A failure of the subcontractor's equipment halted this demonstration. Lessons learned will be incorporated into present and future planning for the ISG Project.

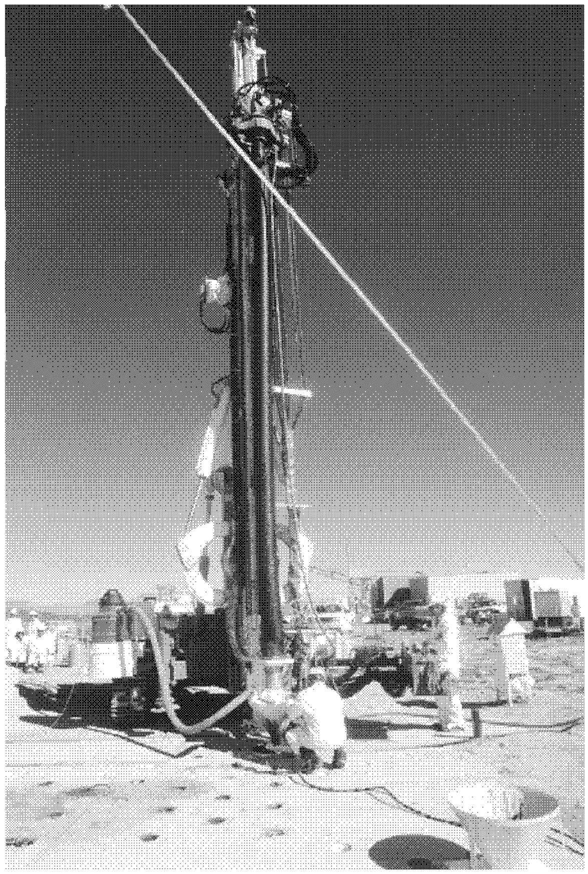

Figure A-1. Picture of jet grouting operation at the Idaho National Engineering and Environmental Laboratory.

The *Evaluation of In Situ Grouting for Operable Unit 7-13/14* report, issued in 2002 (Armstrong, Arrenholz, and Weidner 2002), summarized the application of ISG to radioactively contaminated waste and soil sites across the United States and reports technology performance data where available. The document presented an analysis of jet grout-emplaced close-coupled barriers demonstrated at Hanford, with participation of Sandia National Laboratory and Applied Geotechnical Engineering and Construction, and full implementation at the Brookhaven Laboratory Glass Hole waste site.

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